

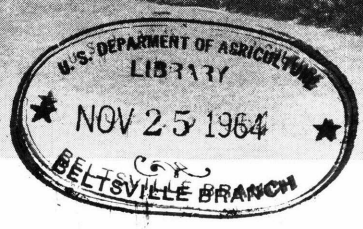
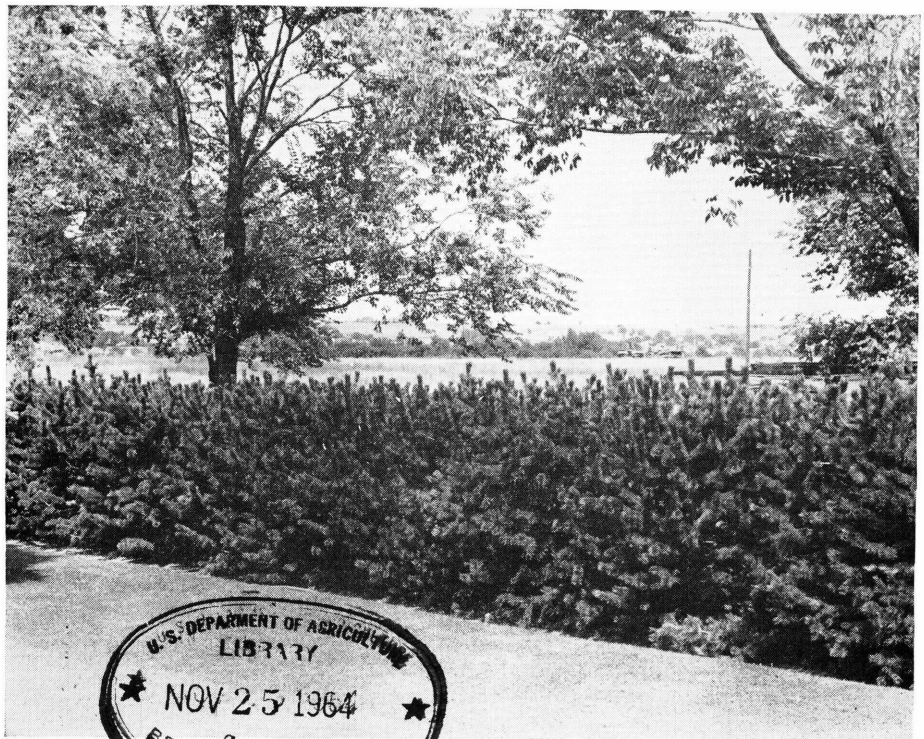
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Ornamental HEDGES

for the
Central Great Plains



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HEDGES are very popular landscape features on the central Great Plains. Being both useful and ornamental, they can be employed in several different ways. Because of errors in selecting the species, inadequate care, and improper pruning, many hedges growing in this region are unattractive or do not serve the purpose for which they were intended.

During the past 18 years the Cheyenne Horticultural Field Station conducted experiments with hedges at Cheyenne, Wyo., and also in cooperative plantings in the surrounding territory. These experiments proved that hedges for almost any desired purpose can be developed satisfactorily on the central Great Plains.

Coniferous evergreen hedges are especially well adapted and are recommended because they furnish shelter and have an attractive appearance during the long winters.

Good soil, good nursery stock, cultivation or irrigation, and control of diseases and insects are as necessary for hedges as for trees and shrubs in any other type of planting. Pruning largely determines whether the hedge is informal or formal and also establishes the shape. Pruning is therefore very important, particularly for formal hedges. The first requisite in pruning any kind of hedge is to have the widest part at the bottom; otherwise the hedge will be open at the base.

Instructions are given for the establishment and care of hedges under Plains conditions. Eighty-three different kinds of plants are evaluated for hedge purposes and their adaption to the soils and climate of the central Great Plains is discussed.

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Cover illustration.—An interesting hedge of bristlecone pine.

ORNAMENTAL HEDGES FOR THE CENTRAL GREAT PLAINS

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HEDGES are probably the most popular type of ornamental planting on the central Great Plains. Some of the reasons for sustained interest in this kind of planting follow:

1. The increasing tendency of farmers and ranchers to beautify their home surroundings with hedges and other ornamental developments.

2. The great demand for all kinds of plantings, such as hedges for landscaping new suburban areas of rapidly expanding cities and towns.

3. The increased need for the privacy afforded by hedge screens as urban subdivisions are laid out with ever-smaller building lots and homes are crowded closer together.

4. The finding, through experimental trials, of trees and shrubs suitable for hedging that are adapted to central Great Plains soils and climate.

On the central Great Plains and in the adjacent Rocky Mountain region most landscape developments in parks, around public buildings, or on home grounds have included some attempt at hedge growing. However, the success achieved and the effects produced are frequently not all that is desired. The many half-dead, scraggly, improperly trimmed hedges encountered in the region indicate that more information is needed on selection of species and on planting, care, and pruning of hedges.

In order to obtain knowledge on hedge growing, extensive experimental tests were undertaken at the Cheyenne Horticultural Field

Station, Cheyenne, Wyo., in 1932. Additional plantings have been made from time to time as new plant material became available. Supplemental test plantings have been made in cooperation with farmers and with various other experiment stations in the region. In addition, a rather complete survey has been made of hedges found growing on the central Great Plains and in the bordering mountain area. Information from all these sources has been used as the basis of recommendations in this bulletin. They apply generally to the central Great Plains of eastern Colorado and Wyoming, northwestern Kansas, western Nebraska, and southwestern South Dakota. These recommendations can also be used in the mountain and intermountain areas of Wyoming and Colorado having growing seasons and winter temperatures similar to those of the central Great Plains.

TYPES OF HEDGES

As commonly used, the term "hedge" signifies trees or shrubs growing close together in a line with their branches touching or interlacing so that the individual plants are not distinct. Generally a hedge consists of a single row or of a staggered row of trees or shrubs. For special landscape effects wider plantings having three to many rows are sometimes employed. Such broad hedges occupy considerable space and are difficult to maintain. They are not recommended for the average garden.

Hedges may be in straight lines, curved, or angled according to the requirements of the site. They may be clipped regularly to some definite form or allowed to develop naturally. Hedges may consist of trees, tall to medium-height shrubs, or low shrubs only a few inches high. For quick effect climbing vines are sometimes trained on fences or trellises as substitutes for hedges. The plants used in hedges may have ornamental flowers or fruits or attractively colored bark. Hedge plants may be deciduous or evergreen. Fortunately the air over Plains cities is not polluted with factory smoke, fumes, and dust, which are very injurious to conifers in eastern industrial centers. Consequently, it is possible to grow coniferous evergreen hedges almost anywhere on the Plains (fig. 1). Evergreens give the same effect the year round; therefore, they are recommended especially for the central Great Plains, where winters are long and winter landscapes are drab.

No one type of hedge can be said to be best for Plains conditions. The type chosen is governed partly by the personal taste of the owner, but mostly by the purpose for which the hedge is intended. If the type selected is suitable for the purpose and if the proper species is used and proper care is given, the hedge will be satisfactory.

PURPOSE AND USE OF HEDGES

Hedges are used in many ways and serve many different purposes. A neat, thrifty hedge is a thing of beauty. As such, it may be the feature of chief interest in the landscape. A hedge can serve also as an attractive background for other plantings, as a low ornamental border in front of shrub groups, or as an edging around formal flower beds (fig. 2). The appearance of walls and buildings often may be

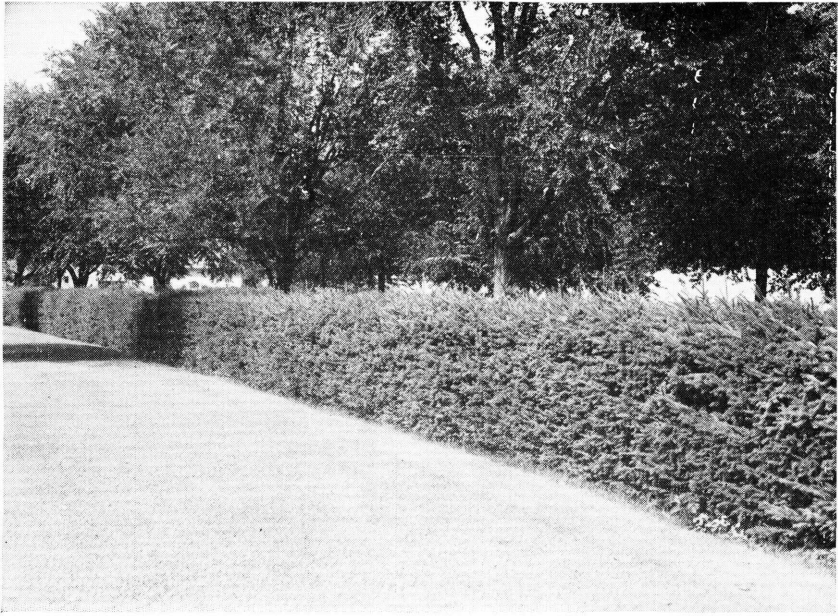


Figure 1.—Black Hills spruce makes a neat clipped hedge.



Figure 2.—Low hedges of Lodense privet used as borders around flower beds.

improved by hedges. Properly placed hedges soften harsh architectural lines or make a pleasing transition between structures and the ground.

To the rural Plains dweller hedges have a particular appeal. The reason is that they are easily arranged about the homestead to provide secluded enclosures that relieve the monotony of the boundless open space.

Hedges are the most utilitarian plantings. They can serve as living walls or fences for separating adjoining properties, for dividing front and back yards, or for enclosing private areas to exclude livestock, neighborhood dogs, or other intruders. In parks and on grounds around school and other public buildings thorny hedges, strategically placed, are the most effective means of directing and confining pedestrian traffic to prescribed walkways. Certainly an attractive barrier hedge is the most ornamental way to prevent the cutting of corners or the wearing of unwanted paths across lawns and flower borders.

Tall hedges are valuable as screens. They may be used to hide unsightly objects or to block out unattractive views. The modern tendency in landscaping home grounds is to develop some part as an outdoor living room or recreational area. Such features call for privacy. On small properties now commonly found in towns and cities, this privacy can best be obtained by tall hedges that screen the area from the view of neighbors and the passing public.

On the central Great Plains hedges are of special value in protecting small areas from wind, drifting sand, sleet, and snow. Service and clothes-drying areas, poultry yards, and kitchen gardens need shelter from the wind. Hedges provide the required protection and also screen these necessary but unornamental facilities from the recreational area and public view. Coniferous evergreens are especially suitable for this purpose as they provide year-round screening and protection.

Within hedged enclosures it is possible to grow many ornamental plants that cannot withstand the buffeting and drying effects of strong winds. Young conifers such as pines, spruces, and junipers are especially subject to damage from wind and blowing sand. On exposed sites it is often advisable to grow temporary hedges to the windward of young coniferous plantings. Some quick-growing deciduous species is used. The temporary hedge is removed after 3 or 4 years, when the conifers are well established.

Hedges serve many useful purposes on the Plains but care should be taken not to overdo them. At best, hedges are formal in appearance. The Plains themselves are also essentially formal in effect, with their unbroken horizon and with section lines, roads, and fences in gridiron design. These formal lines are repeated in laying out fields and in orienting farm buildings and driveways. The same rectangular pattern is followed in plotting streets and building lots in cities and towns.

On such a landscape the simplest kind of planting arrangement is to use hedges in straight lines or at right angles to each other. Too many Plains gardeners seem content to follow this plan. Such planting designs show lack of imagination and are unnecessarily monotonous. The aim should be to lessen the prevailing formality of the Plains rather than to increase it. Hedges should be used where

they are needed. In informal landscaping, however, they should be combined with tree and shrub groups, perennial borders, and other features, in order to break the straight lines and thus reduce the formality.

OBTAINING SUITABLE PLANTING STOCK

Planting stock for hedges should be thrifty and free from insects and diseases. Some dealers offer, at bargain prices, special hedge material, which may be stunted plants that could not be sold as standard specimens. Cull nursery stock is a poor investment. Only well-grown, normal plants should be used for hedges. The plants should be similar in size, shape, and root development because the good appearance of a hedge depends to a considerable extent upon its uniformity. Conifers should be selected for uniform color and texture; otherwise the mature hedge will have a striped effect.

It is generally preferable to plant young trees or shrubs. They are cheaper than large specimens and can be trained readily to the desired shape. For most deciduous hedges 1-year-old plants from seed or cuttings are best. Slow-growing species may be two or more years old. For coniferous hedges seedlings that have been transplanted once in the nursery are preferable. This means that the seedlings are 3 to 4 years old from seed. Older conifers either should have been grown in containers or should be balled and burlapped for moving.

Regardless of cost, some people prefer to start with well-developed hedges and thus avoid waiting for the desired effect. For such customers nurserymen would do well to produce large plants specially trained for hedging. This training is accomplished by proper pruning to encourage low branches and dense tops. In order to stimulate the development of fibrous root systems, the stock is transplanted or root-pruned occasionally. Such ready-made hedges give a mature effect almost immediately after planting, but of course the nursery stock is expensive.

In their zeal to have tall hedges quickly many gardeners make the mistake of setting tall plants which have not been trained for hedging in the nursery. Usually such plants are several years old and are bare of side branches for a considerable distance above the ground. It is impossible to develop these leggy plants into a satisfactory hedge. In order to produce a tight hedge, such high-headed deciduous stock must be cut back almost to the ground and allowed to develop a new top with low side branches. Conifers such as pines, spruces, and junipers without low branches are useless for hedges, as they never fill out at the bottom.

In humid climates hedges are sometimes established by planting seed or cuttings directly in the hedgerows. The advantages are the cheapness of the planting material and the fact that less work is necessary than for setting plants. Planting seed or cuttings is not recommended as a method of establishing hedges on the Plains. In the semiarid climate frequent watering and constant care are necessary to start seedlings or root cuttings. At best the stand is likely to be irregular and the plants ununiform. In the Plains climate it is almost impossible to grow conifers from seed planted in open ground.

If one wishes to save expense by growing his own hedge stock, the seed or cuttings should be started in a small nursery, and the plants

should be transplanted to the hedgerow when they reach proper size. The nursery soil should be fertile, and there should be water available for frequent irrigation. If stock for only a short hedge is to be grown, a row or two at one side of the kitchen garden will suffice for a nursery. However, unless one has enough time and patience to care for the plants properly, it is better to buy young stock from a commercial nursery. Production of conifers from seed requires special seedbeds, partial shade, and extreme care. Amateurs should not try to grow coniferous seedlings on the Plains.

SOIL PREPARATION

Hedges are extremely dense plantings of trees or shrubs. To support such a large number of plants on so small an area, good soil is necessary. Shallow soils underlain by rock, gravel, or hardpan are unsatisfactory. Alkaline subsoil, exposed by grading or thrown out from basement excavations, is not fit for any kind of ornamental planting. Only a deep, rich soil can produce the normal growth and the thrifty appearance essential for an attractive hedge.

If the soil where the hedge is to be located is not suitable, it should be removed to a depth of 18 to 24 inches and replaced with good topsoil. Where replacement of the soil is not necessary, the land should be prepared by deep plowing or spading. Sod land preferably should be broken a year in advance of planting and kept clean-cultivated to kill out grass and weeds. Where water is not available for irrigation, this year of fallow is essential for storing moisture to give the plants a good start.

Addition of peat, compost, or both will prove beneficial, particularly if the soil is very heavy or sandy or is lacking in fertility. A thick coating should be applied and stirred thoroughly and deeply into the soil before planting.

PLANTING THE HEDGE

Early spring, before growth starts, is the proper season for planting hedge plants on the Plains. Fall planting is sometimes practiced. It has no advantages, however, and there are the disadvantages of having to water and protect poorly established plants through a long winter and of the greater danger of loss as compared with spring planting.

When the planting stock is received from the nursery the package should be opened at once and the plants separated. To keep bare-root plants until they can be permanently set, they should be heeled in by inclining them in a shallow trench and covering the roots well with moist soil. Both tops and roots should be watered thoroughly. Roots must not be allowed to become dry. Exposure of roots for even a few minutes to Plains sun and wind often proves fatal, particularly to evergreens. The plants to be set should be removed from the heeling-in trench a few at a time as needed. These should be kept with the roots in a pail partly filled with water or wrapped in wet burlap until planted. Trees or shrubs grown in containers or balled and burlapped do not require heeling in, but they should be planted at once after delivery.

As a hedge grows taller it also becomes wider. The mistake is often made of setting young plants too close to a wall, walk, or driveway with no space for spreading as they develop. No definite rule can be given for the spread of hedges because this varies with the species, the ultimate height, and the degree of clipping. Truehedge column-berry, for example, requires less room for expansion than Tatarian honeysuckle; and a low border hedge does not grow so wide as a tall screen. Unclipped hedges require more space for spreading than clipped ones of the same species. The average clipped hedge 3 to 5 feet high is 3 to 4 feet wide. This means that the plants for such a hedge must be set 18 to 24 inches from a property line, wall, or traffic-way. A spruce screen 20 feet tall needs about 7 feet of space on either side of the row for expansion, while a low edging needs only 3 to 6 inches.

The spacing of plants in the hedgerow depends upon the species and the type of hedge to be developed. Very dwarf plants used in edgings should be set about 6 inches apart. For medium-height hedges the plants should be spaced about 12 inches apart. Trees and large shrubs for high, clipped hedges should generally be spaced 18 to 30 inches apart. Shrubs for untrimmed hedges should be spaced two or three times as far apart as those of the same species for trimmed hedges. For tall screens large trees such as spruce and pine to be grown with little trimming should be spaced 6 to 8 feet apart. Vines employed as hedge substitutes are usually spaced farther apart than shrubs. However, the closer the spacing the sooner the hedge effect is produced. Fast-growing vines may be set 6 or 8 feet apart and slow-growing vines about 4 feet apart.

For closely spaced hedge plants a trench should be dug sufficiently wide and deep to accommodate the roots without crowding or bending. If the soil in which the trench is located has not been disturbed by filling, the topsoil should be piled separately from the subsoil as the trench is dug. The fertile topsoil is filled in first about the roots. Plants should be set about 2 inches deeper than they stood in the nursery. If this brings the bases of some branches underground, so much the better. The roots should be carefully spread with the hands, and the soil should be worked in well around the roots until the trench is a little over half full. After all the plants have been set in this manner, water should be added to fill the trench. The standing water should be allowed to soak in; then plants that have settled out of line should be straightened up and the trench filled with soil. Widely spaced trees and vines may be set in individual holes instead of a trench.

Neither fresh manure nor commercial fertilizer should be put into the trench or holes at the time of planting. Such material coming in direct contact with roots may cause injury. When fertilizers are needed, they should be applied on the surface after planting is done and incorporated into the soil by cultivation or irrigation.

For most types of hedges a single row of plants will prove satisfactory. However, medium-height deciduous hedges that are to be clipped to a formal shape generally will be more effective if set in a staggered row. For such a planting the trench is dug about 10 inches wider than for the usual single row. A line of plants is set about a foot apart on one side of the trench. On the other side a second line is set the same distance apart; but the plants in the second row are set opposite the spaces and not directly opposite the plants in the

first row. This arrangement results in a staggered row or a kind of double row with the distance between the two rows less than the spacing between plants in the rows.

CULTIVATION, IRRIGATION, AND SOIL TREATMENT

The hedgerow should be kept free from weeds and grass by frequent shallow cultivation, hoeing, and hand weeding. On dry land a strip several feet wide on either side of the hedge should be clean-cultivated so that competing vegetation will not rob the hedge of moisture. If water is available for irrigation, it should be applied as needed to maintain normal growth. Fertilizer should be used if the plants show need of it. A nitrogenous fertilizer such as ammonium sulfate or ammonium nitrate or a light application of manure is usually all that is required for woody plants under Plains conditions.

Stimulation of excessive growth by overwatering or by too liberal fertilizing should be avoided. Overstimulated hedge plants merely grow faster and must be trimmed oftener. This adds to the cost of maintenance and does not benefit the hedge. Excessively vigorous plants are also subject to winter injury, particularly if fertilization and irrigation are continued until late in the season. Generally irrigation should be stopped about 6 weeks before freezing weather is expected. This slows down growth and lets the plants harden for winter. Then in late fall, just before the ground freezes, the hedge should be given a thorough irrigation. This is especially important for evergreen hedges. Evergreens profit also from a few irrigations during the winter and in early spring before growth starts. Water should be applied only when the air temperature is above freezing so that the plants will not become coated with ice.

Heavy mulches of strawy manure, straw, or other organic material are often recommended for hedges. Such mulches should not be used under the semiarid conditions of the central Great Plains, particularly for hedges grown without irrigation. If mulches are used, serious stunting or even death of the plants may result.

In soils that are excessively alkaline some species of hedge plants develop iron-deficiency chlorosis. The first symptom of this trouble is a yellowing of leaves on the new growth. Later all the foliage may turn yellow and then become brown. Growth is stunted, and the branches are subject to winter injury. The best solution of this problem is to plant species that are tolerant of alkaline soils. However, where susceptible species have been planted on land that is too alkaline the chlorosis can be cured by application of soluble iron salts to the soil. Ferrous sulfate (copperas) is the cheapest and most effective material to use. Crystals or dry powder should be spread on the soil on both sides of the hedge at the rate of 1 pound to the square yard. Cultivation or irrigation should follow. If the foliage does not turn green after one treatment smaller applications, say $\frac{1}{2}$ pound per square yard, may be made at intervals of 3 weeks until the yellow color disappears.

For large trees and shrubs it is better to put the ferrous sulfate into holes in the soil instead of spreading it on the surface. With a crowbar, a line of holes about an inch in diameter and about 18 inches deep is punched into the soil on either side of the hedge. The holes should be a foot apart and at a convenient working distance from the

hedge. The holes are filled with dry ferrous sulfate, and water is poured down the holes. If the hedge is very large and the root spread is wide, a second or even a third line of holes may be needed. These should be at intervals of 3 feet outside the first line.

Ferrous sulfate will make unsightly stains on concrete, light-colored stone, or brick. Care should be taken, therefore, to keep the chemical or its solution from coming in contact with walls, walks, curbs, and other structures of such materials.

Chelated iron compounds can be applied to the soil to correct chlorosis in hedges. In the central Great Plains it is important to use only the forms of these chemicals that are adapted to alkaline soil; otherwise the treatment will be ineffective. Chelated iron has the advantage of being less likely than iron sulfate to cause injury to plants or to stain brick, stone, or concrete. The iron chelates, however, are more expensive than iron sulfate.

DISEASE AND INSECT CONTROL

Trees and shrubs in hedges are as subject to disease and insect injuries as the same species elsewhere. In the semiarid climate of the Plains insects are especially abundant. Insects attacking hedge plants must be controlled, or the plants will lose their attractive appearance and may die. Fortunately, woody plants on the Plains have few serious diseases. Fire blight occurs on cotoneaster, hawthorn, and flowering quince but is seldom serious on these species in hedges under Plains conditions. A few rusts attack hedge plants. Perhaps the worst one is a cedar rust that produces ugly galls on the Rocky Mountain and savin junipers and also affects leaves of Juneberries and certain hawthorns. Mildews are found on a few hedge species, particularly if the foliage is kept wet by frequent sprinkling. For methods of controlling insects and diseases on hedge plants the State agricultural extension services or State agricultural colleges should be consulted.

PRUNING

Form distinguishes hedges from all other kinds of tree and shrub plantings. Pruning determines the form and is therefore very important. The first aim in pruning any kind of hedge is to encourage low branching. Branches and foliage should extend all the way to the ground. Once the low branches are established, trimming should be such as to keep them in good condition so that the base of the hedge will always be dense and filled out to full width.

As the pruning of deciduous and coniferous hedges is quite different, they are treated separately.

PRUNING DECIDUOUS HEDGES

Immediately after they are set, young deciduous plants should be cut almost to the ground, regardless of their original height. This will cause many side branches to develop close to the ground. For hedges that are to develop their natural form without shearing, no further drastic cutting is necessary. The plants are allowed to grow according to the natural habit of the species. Only corrective pruning is given. This consists of cutting out dead or broken limbs, heading back wayward branches, and thinning out the top to admit sunlight to lower branches. Special care should be taken not to re-

move healthy, low branches, as this produces leggy plants and destroys the beauty of the hedge.

For a trimmed hedge the shoots are cut back sometime during the first winter, so that only a few inches are left at the base of the new growth. This pruning is to force secondary branches close to the ground. Pinching or clipping the tender tips once or twice during the following growing season will cause side branching and make the top dense.

By the third year the planting will have taken on the characteristic of a hedge and trimming to some definite form should begin. One or two clippings a year will be sufficient for most hedges. Edgings, hedges in formal gardens, and hedges of fast-growing species may require more frequent shearing to maintain their trim appearance. Beginners may find it helpful to stretch lines or set up guide stakes along the hedge to insure uniformity in trimming.

The standard hedge shears are the only equipment necessary for trimming formal hedges. These should be of good steel and kept sharp; otherwise they will bruise the branches and produce ragged cuts. Electrically operated clippers will save labor and are particularly desirable if much hedge must be sheared.

PRUNING EVERGREEN HEDGES

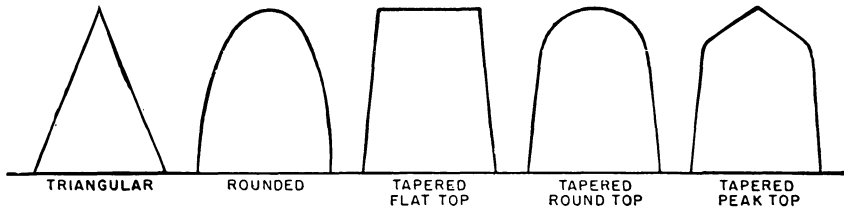
Coniferous evergreen hedges, as mentioned under Obtaining Suitable Planting Stock, must have low branches when set in the hedge-row; otherwise the hedge will never be tight. If a low to medium-height hedge is desired, the plants should be cut back somewhat just after planting to encourage bushiness. For informal evergreen hedges no further pruning is necessary except the removal of dead or broken branches and checking an occasional shoot that is growing out of bounds. Formal hedges of conifers are shaped the same as deciduous hedges. This is done by shearing or pinching back the young growth during the growing season. On pines this is best done in spring by pinching back the emerging shoots, or "candles," before the new needles develop. Conifers that are commonly grown on the central Great Plains should never be pruned back beyond the green foliage. Branches so pruned are likely to die. This characteristic of coniferous evergreens makes it necessary to shape the hedge and control its size as the plants develop.

SHEARING HEDGES TO DEFINITE SHAPES

The shape to which a hedge is pruned is largely a matter of personal taste. There is only one requirement so far as the welfare of the plants is concerned: the bottom must be the widest part of the hedge. Pruning may be severe and frequent to maintain some rigid form as required in a formal garden, or it may be done moderately, once or twice a year, to maintain some general form and to encourage dense growth. Hedges may be trimmed to various shapes as triangular, rounded, or tapered; the tops may be flat, round, or peaked (fig. 3).

Perhaps the simplest form for a trimmed hedge, the best one for the plants, and the one that has the least surface to be sheared is the triangular hedge. This tapers from the ground, to a peak at the top. In localities having heavy snowfall the triangular shape is generally the most satisfactory, because snow tends to pile up on

GOOD HEDGE FORMS



POOR HEDGE FORMS

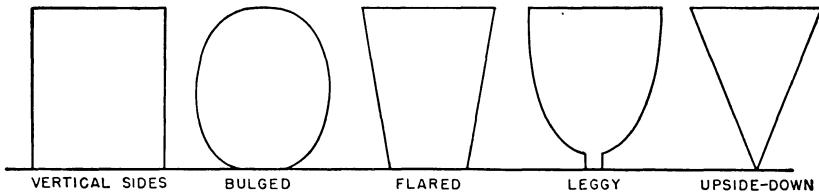


Figure 3.—Some forms to which hedges may be pruned.

broad, flat-topped hedges, and the weight may distort or break the branches. However, the triangular form may not always be suitable. Many landscape designs require hedges having the massive effect of walls, with breadth at the top as well as at the bottom. Even such a hedge may have a slight slope on what seems to be a vertical side without detracting from the appearance. A blocky hedge 5 feet high may have a top 6 inches to a foot narrower than the bottom without being readily distinguishable from a hedge with vertical sides. This taper insures that the lower branches will get sunlight and that there will be a dense growth of foliage down to the ground. In the pruning of formal hedges, the most common fault is to develop a top that is wider than the bottom. Such upside-down hedges soon lose their lower branches and become open at the base.

Some fanciers shear hedges into unusual forms representing animals, birds, ships, and other objects. In large parks such horticultural oddities add interest. However, they are not well suited to small home grounds, as the residents soon tire of such unnatural plant forms. Furthermore, topiary work requires considerable skill and patience and, therefore, is generally not recommended for amateurs.

RENOVATING OLD AND NEGLECTED HEDGES

Hedges that are properly cared for and are of well-selected species will thrive and retain their beauty for centuries. No form of planting, however, suffers so much from neglect or shows the effects of poor care so quickly. Before a neglected hedge that has lost its attractiveness is destroyed, careful consideration should be given to its restoration.



Figure 4.—This leggy hedge of Rocky Mountain juniper should be pulled out.

Old deciduous hedges can be renovated with surprising success if the plants are all alive. A hedge that contains much deadwood or is bare of branches at the base should be cut back almost to the ground and allowed to develop a new top. New tops develop rapidly on plants with large, well-established root systems. Pinching or clipping the young growth of formal hedges to cause branching is practiced as for a newly planted hedge. This is a quicker and cheaper way to obtain a good hedge than replanting.

Deciduous hedges that are well filled out at the bottom but are weak, irregular, or overgrown can usually be rejuvenated satisfactorily without cutting to the ground. The hedge should be pruned as nearly as possible to the desired size and shape, preferably during the dormant season. Insects and diseases attacking the plants should be controlled. If the plants are weak, commercial fertilizer or well-rotted manure should be applied and cultivated or irrigated into the soil. Chlorotic plants should be treated with ferrous sulfate as described under Cultivation, Irrigation, and Soil Treatment. With the usual care the neglected hedge should be restored to a satisfactory appearance in 1 year.

Old coniferous hedges that are bare at the base or badly misshapen should be pulled out (fig. 4). Even if an evergreen hedge is worth renovating no severe pruning, except cutting off some of the top, is possible. A slight amount of shape correction can be done on the sides and top provided it does not involve cutting back beyond the green foliage. There is no such thing as cutting back to the ground an overgrown hedge of pine, spruce, or juniper or severely heading back large branches to correct the form. Disease and insect control, fertilization, and other care should be given as described for deciduous-hedge rejuvenation.

SELECTING SPECIES FOR HEDGES

Almost any kind of woody plant can be developed into some type of hedge. The species selected should, first of all, be adapted to the soil and climate of the locality where it is to be grown. Nothing looks worse in an ornamental planting than a hedge with gaps where plants have died or killed back. A thrifty hedge of common sagebrush is more desirable than a half-dead row of the most expensive boxwood. Where irrigation is not possible, only drought-tolerant species should be planted. Some plants that are hardy to cold will not withstand the dry winds and strong sunlight of the central Great Plains. For example, such plants as yews must have both shade and wind protection. Others, as rugosa rose and flowering quince, will not tolerate alkaline soils. Unless special conditions can be provided such exacting species should not be considered for Plains culture.

The desired dimensions of a hedge should determine to a considerable extent what species is selected for planting. Naturally, a tall hedge can never be developed from a low shrub. Although it is possible to keep a large, fast-growing species such as Chinese elm cut back to form a hedge only a foot high, frequent clipping is necessary and if this is neglected for a short time the trees quickly grow out of bounds. In general, it is preferable to use low-growing species for low hedges, medium-height shrubs for hedges of average height, and trees or tall shrubs for high hedges and screens. Conifers are naturally slow-growing, particularly when crowded together in a hedge. Therefore, normally tall-growing coniferous trees can be developed into medium-height hedges with little effort.

The type of hedge and the purpose for which it is intended also influence the selection of species. For barrier hedges, thorny types such as honeylocust, Russian-olive, buffaloberry, hawthorn, and Japanese barberry are especially desirable. For hedges used as edgings, shrubs with small leaves and fine branches are preferred. Plants with coarse branches and large leaves are best used for background hedges or for informal hedges. Shrubs with showy flowers are particularly suitable for untrimmed hedges. The clipping of hedges removes the flowering wood of most shrubs and trees; therefore, flowering is of little significance in selecting plants for trimmed hedges.

Fortunately the number of woody species adapted to growing on the central Great Plains is large. Experience and experiments have shown that suitable material can be selected for almost any type of hedge and for almost any locality or site.

EXPERIMENTS WITH HEDGE MATERIALS AT CHEYENNE, WYO.

The hedge experiments at the Cheyenne Horticultural Field Station included 73 species, varieties, or forms of trees and shrubs that were under test long enough for proper evaluation. Fifty-two were tested in sheared hedges, and 21 were grown only in informal hedges; some were tested in both types of hedges. Several additional kinds planted in recent years cannot yet be considered as adequately tested and, therefore, are not included in this discussion.

In these trials the spacing of the plants in the hedges varied with the size of the species and the type of hedge. For sheared hedges

small to medium-height shrubs were set 1 foot apart. Trees and large shrubs were spaced 18 to 24 inches apart. Plants in informal hedges were set considerably farther apart than in formal hedges of the same species.

The forms to which the different hedges were sheared varied considerably. Rounded hedges predominated, but there were also ones with tapered sides and flat, rounded, or peaked tops. For the most part, shearing was done twice a year. However, because of the manpower shortage during World War II shearing was neglected a few years. As a result, some of the hedges became overgrown or leggy. These had to be cut back and allowed to develop new tops.

DESCRIPTION AND EVALUATION OF SPECIES FOR HEDGES

A total of 83 species, varieties, and forms of woody plants are described briefly and evaluated for hedge purposes on the central Great Plains. Of these, 10 were not tested in the hedge trials at the Cheyenne Horticultural Field Station but have been observed growing as hedges or substitutes elsewhere in the region. However, all the plants listed have been tested at the station in hedges, in group plantings, or as single specimens so that their adaptation is known.

TREES AND SHRUBS

Acer ginnala Maxim.—Ginnala, or Amur, maple is a small tree of bushy habit with small leaves that turn deep red in autumn. It is suitable for sheared hedges about 4 feet high and 4 feet wide and for tall screens 12 to 15 feet high. As an informal hedge it tends to become leggy unless carefully pruned. The tree is hardy and drought-resistant, but very susceptible to chlorosis in alkaline soils.

Acer negundo L.—Boxelder is hardy, moderately drought-resistant, and adapted to a wide variety of soils. It can be sheared to form a dense hedge about 7 feet tall and 6 feet broad. The coarse branches and foliage make this tree suitable only for background hedges and windbreaks.

Amorpha canescens Pursh—Leadplant is a hardy, drought-resistant native shrub, moderately tolerant of alkaline soils. It has gray foliage and clustered spikes of violet flowers. The sprawling growth habit makes it unsuitable for clipped hedges, but it is effective as an informal, summer-flowering hedge about 2 feet high and 3 feet wide. Winter pruning is necessary to preserve a neat appearance.

Amorpha fruticosa var. *angustifolia* Pursh—False-indigo is an extremely hardy, drought-resistant native shrub, tolerant of alkaline soils and suitable for informal hedges in difficult situations. Its lacy foliage, graceful, drooping branches, and spikes of dark-purple flowers give an interesting effect. It is not recommended for sheared hedges, because it tends to be bare at the base. Its height is about 8 feet and its spread about 8 feet.

Artemisia abrotanum L.—Southernwood, or old man, is much used for hedges in the coldest parts of the central Great Plains. The top is not fully hardy, killing back most winters, but the roots and the bases of the stems survive and quickly send out new shoots that can be sheared into a dense hedge about 3½ feet high and 2½ feet wide. Hedges of this species are best when cut nearly to the ground each

spring. The shrub is drought-resistant and adapted to various soils. The foliage is finely cut and aromatic, but the shrub is not highly ornamental. However, southernwood makes cheap, dependable hedges for exposed locations and is first choice as temporary shelter for young coniferous plantings.

A dwarf form of southernwood, about 18 inches high, can be sheared to form low hedges or edgings.

Berberis thunbergii DC.—The common form of Japanese barberry is a spiny, spreading shrub that makes a good informal hedge about 3 feet high, or it can be grown as a sheared hedge about 2 feet high and 2½ feet wide. The autumn foliage is of a rich red color, and the bright-red berries persist all winter. True hedge columnberry (*B. thunbergii* forma *erecta* Rehd.), an upright form of *B. thunbergii*, is excellent for narrow, clipped, low to medium-height hedges. Japanese barberry is not hardy in the coldest parts of Wyoming and Colorado but is adapted to the mildest parts of the central Great Plains and of the neighboring intermountain area. In the tests at Cheyenne the species survived, but it is subject to killing back except in well-sheltered situations. It is very susceptible to chlorosis in alkaline soils. A red-leaved form (*B. thunbergii* forma *atropurpurea* (Chenault) Rehd.) proved somewhat less hardy than the common type in trials at Cheyenne.

Betula occidentalis Hook.—Mountain birch is a small tree, native to the Rocky Mountains. This species is only moderately tolerant of alkaline soils, but is unusually drought-resistant for a birch. In these trials it made a good clipped hedge 3½ feet tall and 3½ feet wide.

Caragana arborescens Lam.—Siberian pea-tree is extremely resistant to cold and drought and thrives in the most exposed situations. It is much used as hedgerows on the windward side of windbreaks. It makes an untrimmed screen 12 to 15 feet high, but tends to become bare at the base with age. Although the branches are rather coarse for shearing, this shrub can be grown as sheared hedges 4 to 5 feet high and 4 feet wide. Special care must be taken in trimming; otherwise the top becomes wider than the bottom and a leggy hedge results. The foliage generally takes on a dull, yellowish cast in late summer and sometimes drops prematurely. Despite its faults, Siberian pea-tree is the most extensively used hedge plant on the central Great Plains. The species is fairly tolerant of soil alkalinity, but does not thrive in wet places or where the water table is near the surface.

Caragana aurantiaca Koehne—This dwarf caragana is a spiny, low shrub, tolerant of different soils and extremely hardy to cold and drought. Its orange-colored flowers in late spring and its bluish-green foliage make this species very attractive. It can be developed into an excellent low ornamental hedge. In climates too cold for Japanese barberry this caragana is a good substitute. It makes an informal hedge about 3 feet high and 3 feet wide or a sheared hedge 2 feet or less in height and about 2 feet wide.

Caragana frutex (L.) K. Koch—This caragana is hardy and drought-resistant. It can be grown as an informal hedge 5 feet tall or as a sheared hedge 3 feet high and 2½ feet wide. Its suckering habit may be objectionable in some locations although it did not spread rapidly or widely in these trials. The branches are spineless.

The species is not particularly outstanding as a hedge, because of its dull foliage color and the tendency of its slender branches to lop under the weight of snow.

Caragana microphylla Lam.—Littleleaf caragana is the most desirable of the caraganas for average-height hedges. Its rather erect habit, slender branches, and fine foliage make this shrub very suitable for shearing. It is smaller and slower in growth than the Siberian pea-tree and can be kept trimmed to a height of 3½ feet and a width of 3 feet. Untrimmed it makes an attractive informal hedge 5 feet tall. The species is hardy, drought-resistant, and tolerant of alkaline soils.

Caragana pygmaea (L.) DC.—Pigmy caragana is a dwarf spiny shrub, similar to *C. aurantiaca* but not so upright or neat in appearance. It is very hardy and adapted to Plains soils. It can be grown as an informal hedge 3½ feet high and 4½ feet wide or as a low, clipped hedge or edging. A low hedge of this species around the base of coniferous evergreens is an effective and ornamental means of protecting them from dogs. The hedge should be far enough away from the evergreens to avoid crowding. The species is susceptible to spider mite, or red spider, attacks.

Cercocarpus montanus Raf.—Mountain-mahogany is a little-known native shrub that is very hardy to cold and drought and is tolerant of all kinds of soils. Although not so dense a shrub as is desirable, it makes an acceptable clipped hedge 3½ feet high and 3 feet wide. It is especially recommended for difficult situations.

Chaenomeles speciosa (Sweet) Nakai.—Flowering, or Japanese, quince is not hardy in the coldest parts of the central Great Plains and the adjacent mountain area, and it is very susceptible to chlorosis in alkaline soils. Therefore, it can be recommended only for the mildest parts of the region and for acid or neutral soils. Wherever this species is adapted it makes an attractive hedge, with its glossy, green leaves and showy flowers in early spring. It can be used as an informal flowering hedge 4 to 5 feet tall or as a clipped hedge 4 feet tall and 3 feet wide.

Chrysothamnus nauseosus var. *graveolens* (Nutt.) H. M. Hall.—Rabbitbrush is a native shrub, hardy throughout the central Great Plains and intermountain region and tolerant of alkaline soils. Its goldenrodlike flowers are showy in summer and its apple-green branches are attractive in winter. Rabbitbrush makes an interesting clipped hedge about 3½ feet high and 3 feet wide; however, it becomes sprawly unless regularly trimmed. Although rabbitbrush is a desert species, the shrubs when crowded together in a hedge are improved by occasional early-summer irrigation.

Cornus stolonifera var. *coloradensis* (Koehne) Schneid.—The native dogwood, common throughout the Rocky Mountain States, makes an excellent informal hedge about 8 feet high. The shrub is dense and well-filled-out at the base. It flowers and fruits throughout the growing season. The foliage takes on a deep-red color in autumn, and the red bark on the branches brightens the winter landscape. The species is hardy and moderately tolerant of alkaline soils, but not particularly drought-resistant. It was not tested as a sheared hedge in the trials at Cheyenne but should be suitable for that purpose as it is nonsuckering and has a twiggy growth habit and the foliage is small for dogwood.

Cotoneaster acutifolia Turcz.—Peking cotoneaster made the most attractive and generally most satisfactory clipped hedge in these trials. It is hardy throughout the region, drought-resistant, and moderately tolerant of soil alkalinity. The leaves appear early in the spring, and the small glossy foliage covers the bush from top to bottom. Peking cotoneaster can be sheared easily to a height of $3\frac{1}{2}$ feet and a width of $2\frac{1}{2}$ feet. The shrub is sometimes attacked by oystershell scale, which can be controlled by spraying.

Cotoneaster integerrima Medic.—European cotoneaster was tested only as an informal hedge, for which purpose it proved satisfactory. The shrub is very hardy and drought-resistant. It makes a somewhat spreading growth about 5 feet high and 6 feet wide. The bluish-green foliage and the red berries are attractive.

Cotoneaster racemiflora var. *soongorica* (Regel & Herd.) Schneid.—This cotoneaster made a magnificent untrimmed hedge in the trials at Cheyenne. The shrub is hardy; the flowers are as showy as those of Vanhoutte spirea; and the large red fruits are conspicuous against the bluish-green foliage. Because of the horizontal branching habit the species makes a wide hedge with a spread of about 8 feet and a height of about $6\frac{1}{2}$ feet. The shrub was not tested as a sheared hedge, but the growth habit and type of foliage indicate that it could be sheared satisfactorily.

Elaeagnus angustifolia L.—Russian-olive is drought-resistant and tolerant of moderately alkaline soils. Individual trees differ in cold resistance. Irrigated hedges of this species are subject to winter injury when watering is continued late in the summer. The small, gray leaves and the silvery branches and berries are distinctive and make an interesting contrast with other vegetation. Russian-olive can be grown as an informal hedge or screen 15 feet high or sheared to a height of 5 feet and a width of 4 feet. The thorns make hedges of this tree good barriers. Special care is necessary in shearing, as old hedges tend to become bare at the base.

Elaeagnus commutata Bernh.—Silverberry is a very hardy, drought-resistant native shrub suitable for the coldest parts of the region. As an informal hedge about $6\frac{1}{2}$ feet high it is unusual because of its silvery leaves, fragrant flowers, and silver berries that persist all winter. Closely clipped, it makes a striking hedge 4 feet high and 3 feet broad. It requires regular shearing and if shearing is neglected the hedge becomes straggly and requires drastic cutting back. In cultivated ground the shrub suckers badly, and if the sprouts are not controlled it forms a thicket.

Forestiera neomexicana Gray—Wild olive, native to the Southwest, is an exceptionally good hedge plant for the central Great Plains. It is hardy, drought-resistant, and tolerant of alkaline soils. It can be sheared to form a hedge $3\frac{1}{2}$ feet high and 3 feet broad. The fine branches and small foliage resemble the privets, for which this forestiera is a good substitute in cold climates.

Gleditsia triacanthos L.—Honeylocust is drought-resistant and tolerant of various Plains soils, but individual trees vary in hardiness to cold. In these tests trees of this species developed into a good clipped hedge 7 feet high and 5 feet wide. The thorny type makes an impenetrable barrier. Honeylocust grows rapidly, particularly under irrigation, and therefore requires frequent and regular pruning to keep it under control and to prevent it from becoming leggy.

Halimodendron halodendron (Pall.) Schneid.—Salt-tree is a very hardy, drought-resistant shrub, tolerant of alkaline soils. Its pink flowers resemble sweet peas and make a pleasing contrast with the blue-green foliage. The species is attractive as a sheared hedge about 3½ feet high and 3 feet broad, and the sharp thorns discourage intruders. The shrub suckers badly and forms a thicket unless the sprouts are controlled. In some irrigated valleys of the West, this shrub has escaped and become a pest. Some Canadian nurseries graft salt-tree on *Caragana arborescens* understock to avoid suckering.

Juniperus × *media* van Melle 'Pfitzeriana'.—Pfitzer's juniper is hardy, drought-resistant, and adapted to a wide variety of soils. The foliage is subject to "winter burn" if exposed to winter winds. The species is widely used on the central Great Plains as an informal hedge. It can also be sheared to form a dense, formal hedge 2½ feet high and 2 feet wide.

Juniperus monosperma (Engelm.) Sarg.—Oneseed juniper is a hardy native tree, very resistant to drought and moderately tolerant of soil alkalinity. It makes an interesting informal hedge or tall screen and can be grown as a sheared hedge about 6 feet tall and 4½ feet wide. In some localities the species is subject to injury by spider mites and requires spraying or dusting.

Juniperus sabina L.—Savin juniper is a hardy shrub, tolerant of alkaline soils. It is suitable for informal hedge or border plantings and also for clipped hedges. Formal hedges can be kept to a height of about 2½ feet and a width of about 2 feet.

Juniperus scopulorum Sarg.—Rocky Mountain juniper, or western redcedar, is cold- and drought-resistant and moderately tolerant of soil alkalinity. It makes an excellent clipped hedge (fig. 5) and is also desirable as tall informal screens or for windbreaks. Sheared hedges of this species from 3 to 8 feet tall can be found in the region. The species is subject to attacks by aphids and also by spider mites. If these pests are not controlled, they will defoliate the hedge.

Juniperus utahensis (Engelm.) Lemm.—Utah juniper is a very hardy, drought-resistant tree, moderately tolerant of soil alkalinity. It is similar in general appearance to *J. monosperma*, but smaller and more compact. Utah juniper was not grown as a sheared hedge in these trials, but its growth habit indicates that it could be sheared satisfactorily. It made an attractive informal hedge of medium height.

Juniperus virginiana L.—Eastern redcedar is hardy and fairly drought-resistant and tolerant of different soils. It makes a good formal hedge and can be sheared to any height between 2½ and 8 feet. It is much used in windbreak plantings.

Ligustrum spp.—Privets are perhaps the commonest hedge plants in the United States. Their small leaves, dense growth, and amenability to shearing make them well suited for formal hedges. Privets tolerate both sun and shade, and most species are easily and cheaply propagated by cuttings. They are not very drought-resistant and are only moderately tolerant of soil alkalinity. None of the privets is reliably hardy in the coldest parts of the central Great Plains and the adjacent Rocky Mountain region. Amur privet (*L. amurense* Carr.), often listed in nursery catalogs as Amur River North, is reputed to be the hardiest, but it has been winter-injured frequently in the trials at Cheyenne.



Figure 5.—A tall hedge of Rocky Mountain juniper.

The hardiest privets tested are selections of *Ligustrum vulgare* L.: one called Polish privet and another clone introduced from Rumania by the New Crops Research Branch as P. I.¹ 107726. Both have been fully hardy at Cheyenne and make excellent clipped hedges 3½ feet high and 3 feet wide. Another apparently hardy selection of *L. vulgare* not included in these trials is sometimes grown on the Plains. Locally this is called "Swedish" privet, because it was introduced from Sweden by the late D. M. Andrews, Boulder, Colo. (fig. 6). The commonly grown selection of *L. vulgare* is adapted only to the mild parts of the region; this is true also of Thompson privet, a selection of *L. vulgare*, and of Lodense privet, a dwarf form of the species suitable for low hedges and edgings. These have survived in these trials but have not been reliably hardy, killing back in severe winters.

Ligustrum ibota Sieb. & Zucc. and *L. × ibolium* Coe ex Rehd. survived a few years in the tests at Cheyenne but killed back frequently and finally died.

Regel privet (*Ligustrum obtusifolium* var. *regelianum* (Koehne) Rehd.) did not survive long in these tests but can be grown in the mildest parts of Colorado and western Kansas.

Lonicera tatarica L.—Tatarian honeysuckle is a hardy, drought-resistant shrub, only moderately tolerant of soil alkalinity. Given plenty of room, it makes a good informal hedge 12 feet high. In these trials it developed into a good clipped hedge 5½ feet high

¹ P. I. indicates a plant introduction by New Crops Research Branch, Crops Research Division, Agricultural Research Service.



Figure 6.—A curved hedge of "Swedish" privet bordering a driveway.

and 5 feet wide. In any form it tends to legginess and care must be taken to develop and preserve low branches. Unless special attention is given in shearing, formal hedges quickly become broader at the top than at the base. Blister beetles and caterpillars sometimes attack the leaves and defoliate a hedge in a short time if not controlled.

Maclura pomifera (Raf.) Schneid.—Osage-orange survived in the trials at Cheyenne but killed to the ground so frequently that it never made a hedge. This species is recommended for only the mildest parts of the central Great Plains, in southern Colorado and western Kansas, where it is suitable for windbreaks and field hedges.

Morus alba f. *tatarica* (Pall.) Ser.—Russian mulberry is drought-resistant, but generally not very cold-resistant, although certain individual trees are much more winter-hardy than the type. For cold climates nurserymen should select trees of proved hardiness and propagate them vegetatively. Russian mulberry makes a large dense hedge and is used in windbreaks in the mild parts of the central Great Plains. In the trials at Cheyenne it was grown as a sheared hedge but was not satisfactory because the frequent killing back of the new growth produced a ragged appearance. Even where it is winter-hardy it is suitable only for windbreaks or background hedges, as the large leaves and vigorous branches are too coarse for an ornamental hedge.

Picea glauca var. *densata* Bailey—Black Hills spruce is extremely hardy to cold, moderately drought-resistant, and very tolerant of soil alkalinity. It makes a dense sheared hedge 5½ feet tall and 4 feet wide. Because of its dense growth and low-branching habit, it is excellent as a tall, informal screen.

Picea pungens Engelm.—Colorado blue spruce is hardy, drought-resistant, and extremely tolerant of soil alkalinity. It makes an excellent tall screen or windbreak. When planted close together and

sheared the trees can be developed into an excellent formal hedge 5 feet high and 3 feet wide (fig. 7). The trees vary widely in color, and selection should be made for uniformity before they are planted in a formal hedge.

Pinus aristata Engelm.—Bristlecone pine, native to the Rocky Mountains, is hardy and moderately tolerant of alkaline soil. Planted 2 feet apart, trees of this species can be developed into a very attractive sheared hedge 6 or 7 feet high and about 4 feet wide. The tree is fully hardy at Cheyenne and is less susceptible to "winter burn" of needles than most other pine species.

Pinus mugo Turra.—Mugho pine in these trials made an excellent informal hedge 6 feet high and 6 feet wide. The plants tend to be irregular in size and rate of growth, and selection for uniform growth rate before planting is advisable. In these trials pruning back of branches and pinching of the "candles" was necessary to keep the hedge of even height and spread. Occasional winter burning of the needles has occurred. Mugho pine is sometimes attacked by pine needle scale, which is easily controlled by spraying.

Potentilla fruticosa var. *davurica* (Nestl.) Ser.—This white-flowered, shrubby cinquefoil is effective as a low informal hedge 2 feet high and 3 feet wide, but it is not very desirable as a sheared hedge. The shrub is hardy and drought-resistant, but it becomes chlorotic in alkaline soils.

Prunus americana Marsh.—American plum is hardy and drought-resistant, but only slightly tolerant of alkaline soils. It is much used in windbreaks and is effective as an informal hedge for background plantings. In these trials American plum developed into a surprisingly good clipped hedge 4 feet high and 4 feet wide. The suckering habit is sometimes troublesome, and if suckering is not controlled the sprouts develop into a plum thicket.

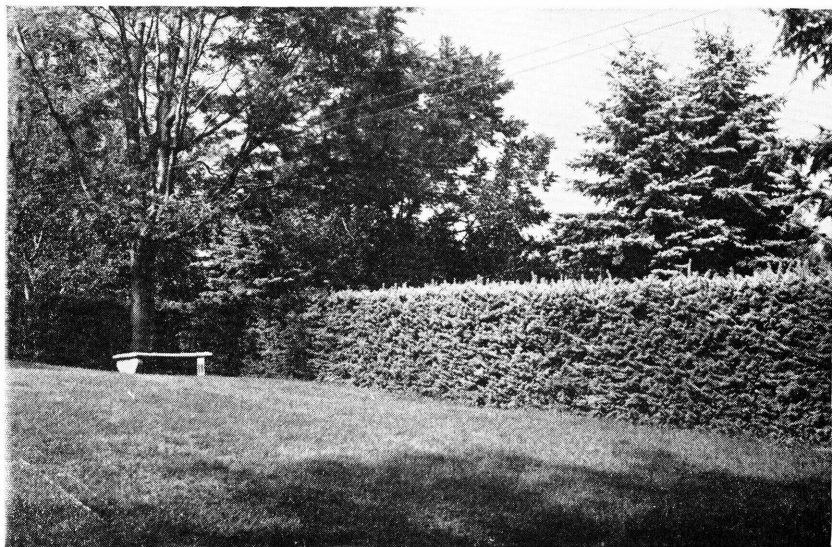


Figure 7.—A formal hedge of Colorado blue spruce gives seclusion to this garden nook.

Prunus besseyi Bailey—Western sandcherry was not satisfactory in these trials as either a trimmed or an untrimmed hedge. Its chief faults are a pronounced susceptibility to chlorosis in alkaline soils and a sprawly growth habit; the plants become almost procumbent in old hedges.

Prunus tomentosa Thunb.—Nanking cherry, tested only as an untrimmed hedge, proved hardy and drought-resistant, but rather susceptible to chlorosis in alkaline soils. Without trimming it makes a dense, round-topped hedge 5 feet high. The foliage is attractive and the early pink or white flowers are followed by red or yellow fruits, which are edible.

Prunus virginiana var. *melanocarpa* (A. Nels.) Sarg.—The native chokecherry is very resistant to cold and drought and is tolerant of different types of soil. Untrimmed it makes a good windbreak or informal hedge about 12 feet high and produces abundant black or yellow fruit useful for making jams and jellies. As a trimmed hedge 6 feet high and 5½ feet wide it is attractive, and the weakly suckering habit merely keeps the hedge well filled out at the bottom. The species is frequently attacked by tent caterpillars.

Ptelea trifoliata L.—Wafer ash is hardy, very drought-resistant, and moderately tolerant of alkaline soils. Its glossy, dark-green foliage and cream-colored flowers make this shrub suitable for dry-land, informal hedges about 7 feet tall and 6 feet wide. The texture is too coarse for formal hedges, and the shrub is inclined to legginess.

Rhamnus cathartica L.²—Common buckthorn is an extremely hardy, drought-resistant shrub, which endures the most adverse conditions of the Plains. It is also very tolerant of soil alkalinity. It is effective as a windbreak or tall informal hedge, and the thorns make it a good barrier. In these trials it also made a good sheared hedge 3½ feet high and 3 feet wide. Some sheared buckthorn hedges in the region are 8 feet tall.

Rhamnus davurica Pall.—Dahurian buckthorn was tested only as an informal hedge. It is tolerant of soil alkalinity, very hardy, and drought-resistant. The growth habit is too open for a sheared hedge, but the shrub is suitable for windbreaks or informal background hedges 8 to 10 feet high.

Rhamnus frangula L.—Glossy, or English, buckthorn did not prove winter-hardy at Cheyenne. It killed back to the ground frequently and never developed into a hedge. It can be recommended only for the mildest parts of the central Great Plains. Where it is adapted it makes an attractive sheared hedge, with glossy foliage and dark-red berries.

Ribes aureum Pursh³—Golden currant is a hardy, drought-resistant native shrub adapted to a wide variety of soils. The fragrant yellow

² Certain buckthorns (*Rhamnus* spp.) are alternate hosts of crown rust of oats. With the possible exception of *R. frangula*, buckthorns should not be planted in areas where oats are commonly grown.

³ Currant and gooseberry (*Ribes* spp.) plants are alternate hosts of white pine blister rust, a destructive disease of white, or five-leaved, pines. The invasion of North America by the white pine blister rust has resulted in quarantines prohibiting or regulating the shipment and growing of currant and gooseberry plants, in order to control the disease. For this reason persons desiring to grow or to ship currant and gooseberry plants should consult the State nursery inspector as to legal restrictions. Information is also available from your county agent, or by writing to U.S. Department of Agriculture, Washington, D.C. 20250.

flowers are followed by edible fruits. The species makes a good informal hedge 5 feet high and 6 feet wide. It is excellent also as a trimmed hedge about 3 feet high. This currant is subject to a bacterial disease, which kills the canes: because individual plants differ in susceptibility, only resistant strains, vegetatively propagated, should be used in hedges.

Ribes cereum Dougl.—Squaw currant is a very hardy, drought-resistant native shrub that can be sheared to a neat hedge 3 feet high and 3 feet wide. However, it cannot be recommended as an ornamental hedge, because the foliage turns a rusty-brown color in late summer.

Ribes leptanthum Gray—This currant, native to the southern Rocky Mountains, is very hardy and drought-resistant and moderately tolerant of soil alkalinity. It made an excellent informal hedge 6½ feet high. It was not tested as a sheared hedge, but the small leaves, dense growth, and sharp spines indicate that this shrub would make a good formal hedge and an effective barrier.

Rosa rubrifolia Vill.—Red-leaved rose makes an unusual hedge, with its purplish-red foliage, reddish branches, and bright-red fruits which persist all winter. In these tests both trimmed and untrimmed hedges became leggy after about 10 years, and it was necessary to cut them back nearly to the ground. The thorns make this rose a good barrier. The sheared hedge is about 3 feet high and 2½ feet wide. Untrimmed hedges reach a height of 7 feet.

Salix purpurea f. *gracilis* (Gren. & Godr.) Schneid.—Ural willow is a quick-growing, hardy shrub with fine branches and bluish-green foliage. It makes an attractive sheared hedge about 4 feet high. Like other willows, it is not drought-resistant and is not very tolerant of alkaline soils. It grows out of bounds if not regularly sheared, and the appearance is improved by cutting back almost to the ground every 5 or 6 years. Arctic willow, a form of *Salix purpurea* more dwarf than Ural willow, is effective as a low, clipped hedge. The purplish-red branches give an interesting color effect in winter.

Shepherdia argentea (Pursh) Nutt.—Buffaloberry is a very hardy, drought-resistant, tall shrub, not particular as to soils. In these experiments it was tested both as a sheared hedge and as an informal hedge or screen and proved very suitable for both types. The thorns make these hedges good barriers, and the small gray leaves are attractive. The suckering habit was not objectionable in these trials. There are male and female plants, the latter producing attractive red or yellow berries which are valued for jelly. Plants of both sexes must be included in a hedge in order to obtain fruit. Buffaloberry can be sheared easily to a height of 3½ feet and a width of 3 feet; as a screen it reaches a height of 14 feet. Oystershell scale sometimes attacks the shrubs.

Spiraea × *arguta* Zabel—Garland spirea, generally considered hardy to cold, did not prove satisfactory in these trials. The shrubs become chlorotic in soils that are only slightly alkaline and the weakened plants winterkill. Garland spirea can be recommended for the central Great Plains-Rocky Mountain areas only where soils are acid or neutral and where some irrigation is possible.

Spiraea × *bumalda* Burv. 'Froebelii'.—Froebel spirea is extremely susceptible to chlorosis in alkaline soils and not especially drought-

resistant. In the trials at Cheyenne it killed to the ground most winters; but the roots survived, the plants behaving as herbaceous perennials. It is attractive because of the red foliage in spring and fall and the rosy flower heads in summer. It is recommended as a low, informal, flowering hedge where irrigation is possible and where soils are nearly neutral or acid.

Spiraea × vanhouttei (Briot) Zabel—Vanhoutte spirea, often cataloged in the nursery trade as spirea V. H., is used extensively on the Plains for informal flowering hedges. The shrub is rather hardy, but on soils only moderately alkaline the plants become chlorotic and winterkill. In these experiments it made an excellent sheared hedge 3 feet high and 3½ feet wide.

Symphoricarpos occidentalis Hook.—Wolfberry is hardy, drought-resistant, and moderately tolerant of alkaline soils. It made an attractive clipped hedge 2½ feet high and 3 feet wide. The suckering tendency was not objectionable, suckering serving merely to keep the hedge filled out at the base.

Syringa chinensis Willd.—Chinese lilac, commonly sold in the Plains States as Persian lilac, is hardy, drought-resistant, and tolerant of alkaline soils. It is excellent as an informal flowering hedge and was one of the best trimmed hedges in these trials. As an informal hedge it reaches a height of 10 feet but can be kept sheared to a height of 2½ feet and a width of 3 feet.

Syringa oblata var. *dilatata* (Nakai) Rehd.—This lilac is hardy to cold and drought and adapted to alkaline soils. The early, fragrant flowers and red autumn foliage make this species excellent for informal hedges about 6½ feet tall. This species was not sheared in the tests at Cheyenne, as its large leaves seemed to make it unsuitable for formal hedges.

Syringa vulgaris L.—Common lilac has been used extensively on the central Great Plains for both sheared and informal hedges. The species is hardy, drought-resistant, and tolerant of soil alkalinity. However, it suckers badly, the flower buds are frequently killed by late-spring frosts, and the texture is too coarse for formal hedges. As an informal hedge it has nothing to recommend it over the lilac species just described and the many excellent French hybrids of which the common lilac is a parent.

Ulmus pumila L.—Chinese elm⁴ is a fast-growing tree, which has been used extensively for hedges on the central Great Plains. When planted closely and sheared frequently this elm makes a good formal hedge, either tall or of medium height. However, if shearing is neglected, the hedge quickly gets out of bounds and drastic pruning is necessary. The species is susceptible to the widely distributed European elm scale. Chinese elm does best under dry-land conditions and should not be planted in wet lands. Overirrigation and watering in late summer should be avoided. Individual trees vary in hardiness, and this variation often results in gaps in the hedge because trees die or kill back. To overcome this difficulty, spacing of plants a foot apart is recommended for formal hedges.

Viburnum lantana L.—Wayfaring-tree is hardy, but only moderately tolerant of soil alkalinity and drought. It was not tested as a

⁴This elm, commonly called Chinese elm in the regions where it is grown most extensively, is called Siberian elm by some botanists. The true Chinese elm is *U. parvifolia* Jacq.

sheared hedge in these trials, but it made an excellent informal hedge, dense from top to bottom and attractive in flower, fruit, and foliage. It is about 8 feet in height and has a spread of 10 feet.

Viburnum trilobum Marsh.—American cranberrybush proved totally unsuitable for hedges in the trials at Cheyenne. It is very susceptible to chlorosis in alkaline soils, and chlorotic plants freeze back in severe winters.

VINES AS SUBSTITUTES FOR HEDGES

Aristolochia durior Hill—Dutchmans-pipe is a vigorous twining vine adapted to various soils and hardy on most of the central Great Plains. It is much used on porches and fences as screens, for which purpose it is well suited because of its large, overlapping leaves.

Clematis ligusticifolia Nutt ex T. & G.—The native virgins-bower is drought-resistant and extremely hardy and makes a dense vine cover for fences and trellises. The attractive white flowers are followed by plumed seed clusters, which are showy in autumn.

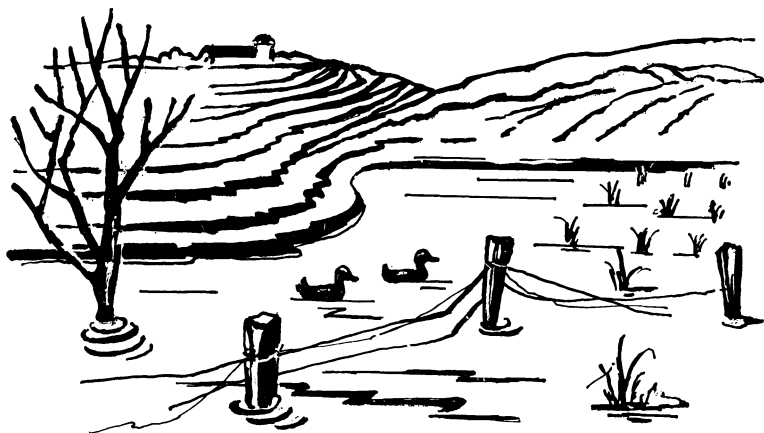
Lycium halimifolium Mill.—Matrimony-vine is extremely hardy to drought and cold and is tolerant of soil alkalinity. This is really a shrub with long drooping branches that do not cling or twine like true vines. However, when given some support and sheared matrimony-vine makes a presentable hedge. It is planted frequently on the central Great Plains. It is especially recommended for severe and exposed locations where other vegetation does not thrive. The suckering habit makes this species undesirable for planting on well-kept grounds where growing conditions are favorable for other plant materials.

Parthenocissus quinquefolia (L.) Planch.—Woodbine, or Virginia creeper, is hardy, drought-resistant, and moderately tolerant of soil alkalinity. Supported by wires or fences it is commonly used throughout the central Great Plains as a hedge substitute. Besides the common type, there are several varieties and forms, the more common being Engelmann ivy (*P. quinquefolia* 'Engelmannii') and St. Paul ivy (*P. quinquefolia* var. *saint-paulii* (Koehne & Graebn.) Rehd.), both of which cling to stone or brick walls. When given support, all are equally satisfactory. Pruning is necessary to keep the vines within bounds. The foliage takes on an attractive red color in autumn. Leafhoppers sometimes attack and discolor the leaves but are easily controlled by modern insecticides.

Polygonum aubertii L. Henry—Silver-lace vine is a fast-growing drought-resistant vine that makes a dense screen. The top is not fully hardy in the coldest parts of the central Great Plains, killing back in severe winters. However, the root generally survives and in spring sends out new shoots which soon develop into a dense cover. Trained over a fence or trellis, silver-lace vine makes an attractive substitute for a hedge. The foliage is bright green, and the lacy panicles of white flowers in late summer are very ornamental.

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